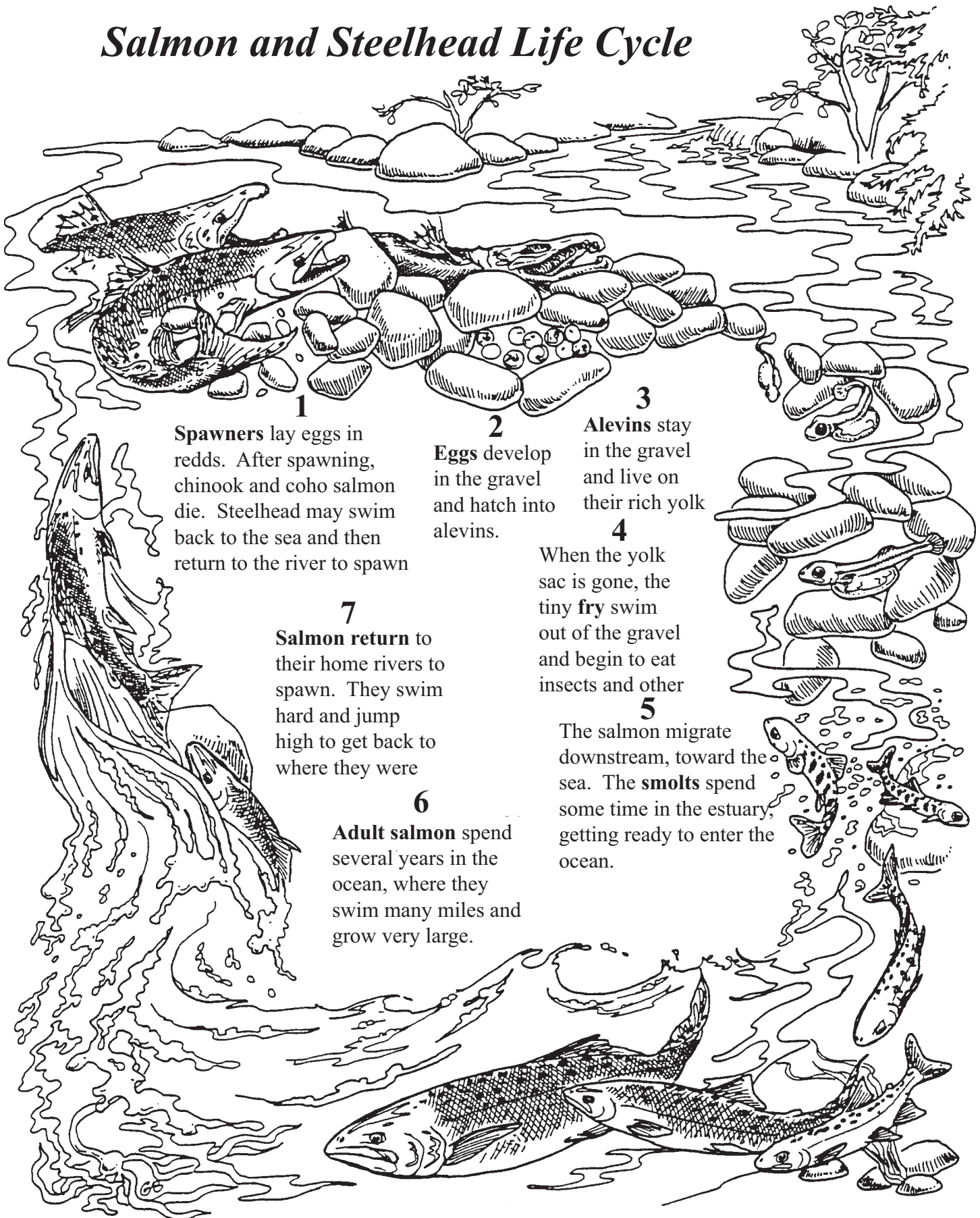


Salmon and Steelhead Life Cycle



1
Spawners lay eggs in redds. After spawning, chinook and coho salmon die. Steelhead may swim back to the sea and then return to the river to spawn

2
Eggs develop in the gravel and hatch into alevins.

3
Alevins stay in the gravel and live on their rich yolk

4
When the yolk sac is gone, the tiny **fry** swim out of the gravel and begin to eat insects and other

5
The salmon migrate downstream, toward the sea. The **smolts** spend some time in the estuary, getting ready to enter the ocean.

6
Adult salmon spend several years in the ocean, where they swim many miles and grow very large.

7
Salmon return to their home rivers to spawn. They swim hard and jump high to get back to where they were

Illustration and text from *Salmon and Trout Go to School: An Illustrated Manual for Hatching Salmon and Trout Eggs in Classroom Aquarium-Incubators*, written by Diane Higgins, illustrated by Gary Bloomfield, and funded by Steelhead Trout Catch Report-Restoration Card.

The Salmon Story

Objectives

Students will: (1) describe the parts of the salmon life cycle and (2) Identify hardships and obstacles salmon encounter during the migration cycle.

Curricular Areas

Language Arts, Science, Math, Art, and Social Studies

California Content Standards

GRADES preK-4

Science

K Life 2 b, c; Earth 3 a; Investigations 4 c, d, e

1st Life 2 a, b, c; Investigations 4 d

2nd Life 2 a, b; Investigations 4 c, d (Extension)

3rd Life 3 a, c, d

4th Life 2 b, 3 c

Math

K Numbers 1.0, 2.0; Algebra 1.0; Data 1.0; Reason 1.0, 2.0

1st Numbers 1.0, 2.0; Data 1.0, 2.0; Reason 1.0, 2.0

2nd Data 1.0; Reasoning 1.0, 2.0

Social Studies

K K.4, K.5

1st 1.2, 1.5

2nd 2.1, 2.2

3rd 3.1

4th 4.1

English Language Arts

K Written/Oral 1; Listen/Speak 1.0, 2.0

1st Written/Oral 1; Listen/Speak 1.0, 2.0

2nd Written 2.0 (Extension); Written/Oral 1.0; Listen/Speak 1.0, 2.0

3rd Written 1.0, 2.0 (Extension); Written/Oral 1.0; Listen/Speak 1.0, 2.0

4th Written 1.0, 2.0 Extension; Written/Oral 1.0; Listen/Speak 1.0, 2.0

Method

Students create a salmon life cycle bracelet using eight to twelve different colored beads. Each bead represents a part of the cycle in a story they construct.

Materials

- Time to complete: (1) 50-minute class period
- Storybook: *Salmon Stream* or *The Salmon*
- Medium sized Pony beads; at least 12 colors (more if possible)
- Satin or leather cording

Background

The life cycle of a Chinook salmon begins when the female deposits eggs in a shallow gravel depression. Once deposited, the male fertilizes the eggs. Newly hatched salmon, called “alevin,” live in the gravel and survive by absorbing proteins from their yolk sacs. After a few weeks, the yolk sacs are gone and the small fish, known as ‘fry,’ move into deeper water to find food on their own. Salmon remain in freshwater streams feeding and growing for many months or even years before migrating downstream to the ocean. These small ocean-bound salmon are called fingerlings. Before the fingerlings enter the ocean they spend time in an estuary, an area where saltwater and freshwater meet and mix. In the estuary, the fingerlings’ body changes in preparation for the ocean saltwater. This process is called “smoltification” and the salmon are now called “smolts.” Chinook smolts grow to adults in the Pacific Ocean. In the ocean the salmon grow rapidly by feeding on other fish, shrimp and crustaceans. The salmon also encounter many dangers including sharks, killer whales, other marine mammals, and humans who are also fishing for salmon. After two to five years in the ocean, they begin the journey that guides them back to their birth site. Salmon have an inherent ability to return to their original streams. Juvenile salmon imprint or memorize the unique odors of their home stream. As returning adults they use their sense of smell to guide them upstream to where they hatched. Once in their home stream, salmon spawn and then die.

Procedure

Before class:

Create a salmon life cycle bracelet to use as an example.

During class:

1. Ask students if they have heard the term migration. Define the term and provide an example (ducks migrate each year). Do other

- animals migrate? Introduce the fact that some fish migrate.
- Read students the book, *Salmon Stream* or *The Salmon*. The story follows the life cycle of the Pacific salmon. After the story, have students discuss each stage of the salmon's life. Use the life cycle illustration before this activity.
 - Explain that each student is going to create a story about the life of a salmon. Show the students the salmon life cycle bracelet. Explain that the bracelet forms a circle like the life cycle. The bracelet, which is a form of art, can be used to tell a story about the salmon. Throughout time people of all cultures have used art to tell stories and to teach. Ask if anyone knows a culture that uses storytelling and art to teach. Write down ideas, for example, totems and cave paintings.
 - Show the students the colored beads. Each student will decide the colors they will use to represent each stage of the life cycle. Students can designate colors for obstacles or hazards that their salmon will encounter during its life. Each bead will tell a part of the story about the salmon as it grows, changes, and travels.
 - Have students choose about 8 to 12 beads of different colors. Cut a piece of cording approximately 12" per student. Knot one end

of the cord and have students create their story bracelet.

- Have students share their stories first in small groups of 3 to 5, then to the class. Encourage students to share the story bracelet with their family.

Extension

- Have students write out their salmon life story and illustrate it.
- Use music or rhythm to add to the story.
- Create a life cycle puzzle. Provide each student with a copy of a large circle. Have students divide the circle into six equal parts (like slicing a pie). In each section have them write the word for one part of the salmon life cycle (spawning adults, eggs, alevins/fry, fingerlings, smolts, ocean salmon). Have students draw a picture to represent each stage. When drawings are complete, the circle can be cut out and the sections cut apart. Students can then assemble and reassemble this circle as a puzzle.

Suggestions for Color of Beads and their

SALMON STAGES	PREDATORS
Orange–salmon egg Red–alevin Light Blue–fry Teal Blue–smolts Light Blue–fingerlings Gray–ocean salmon Light Green–returning adults	Purple–large fish Dark Gray–seal Black–whale Yellow–humans Brown–bear
HABITAT	FOOD
Clear–fresh water Dark Blue–ocean	Light Brown–insects Pink–shrimp

The Great Anadromous Fish Game

Objectives

Students will: (1) describe the seasonal migration of anadromous fish, (2) identify a variety of natural and human factors that affect the reproductive success of anadromous fish, and (3) apply mathematical skill to biological problems.

Curricular Areas

Science (observing, organizing, communicating),
Math (multiplication by fractions or decimals, subtraction, rounding off), Mechanical (use of a calculator, graphing)

California Content Standards

GRADES 4-8

Science

4th Life 2 a, b; 3 a, b, c

5th Earth 3 a; 4 a, b, c

6th Earth 4 a, b; Ecology 5 a, b, c, d, e; Resources 6 a, b, c; Investigations 7 b, e, g, h

7th Evolution 3 a, d, e; Living Systems 5 a, b, d; Investigations 7 a, c

Social Studies

4th 4.1, 4.5

Math

3rd Number 1.0, 2.0, 3.0; Data 1.0; Reason 1.0, 2.0, 3.0

4th Number 1.0; Data 1.0, 2.0; Reason 1.0, 2.0, 3.0

5th Number 1.0, 2.0, Data 1.0; Reason 1.0, 2.0, 3.0

6th Number 1.0, 2.0; Data 1.0, 2.0, 3.0; Reason 1.0, 2.0, 3.0

7th Number 1.0; Data 1.0; Reason 1.0, 2.0, 3.0

English Language Arts

4th Speaking 1.0, 2.0

5th Speaking 1.0, 2.0

6th Speaking 1.0, 2.0

7th Speaking 1.0, 2.0

Materials

- Time to complete: (1) 50-minute class period
- For each group of 2-8 players:
- game board (follows activity)
 - worksheets to keep score
 - sets of cards (make a set of cards for each 3

players)

- a die
- 2-8 salmon or other markers for players to move
- storage box such as a shirt box
- vocabulary sheets
- calculator if not doing math by hand

Background

Migration is the movement of animals from one area to another. Many species migrate seasonally. In this game, salmon seasonally migrate from the open ocean through estuaries and into freshwater rivers and streams where they spawn (lay their eggs). The newly hatched young must then migrate back down the rivers to the ocean. Fish that follow this pattern are said to be anadromous from the Greek word for “running upward.” Both the adults and the young face a number of hazards, some natural and some from humans. As the students play this game, they will learn about these hazards.

Procedure

Before class:

- Construct the game board and game cards.
For repeated use, laminate game pieces. Copy the cards and glue to different colors of construction paper. Copy the worksheet.

During class:

- Ask students what they know about migration. Have students name animals that migrate. Why do animals seasonally migrate? Is it climatic changes that affect food supply and reproductive potential? Example, humpback whales migrate to cold northern waters to feed in summer and move south to warmer water to calve during the winter. Canadian geese migrate each spring to breed in the northern U.S. and Canada, and then they migrate south each fall to winter feeding grounds in the southern regions of the United States. What about fish?
- Review the life cycle of the salmon.
- Introduce the Great Anadromous Fish Game. In this game, students will be salmon migrat-

ing from the ocean (where they feed and grow to adults) into rivers and creeks to spawn and release eggs, which are fertilized outside the female's body.

5. Have the students predict some of the hazards they are likely to encounter during their migration. Make a list of the prediction on the board.
6. The students will keep track of their population size on worksheets. Graph the decline of fish as they swim upriver and the decrease of offspring as they swim down to feeding grounds in the sea.
7. To conclude, review the students list of hazards. Did they include:
 - predation by a wide variety of predators
 - food supplies
 - changes in water level from lack of rainfall
 - abnormal temperatures
 - unusually severe storms
 - parasites and diseases
 - water pollution
 - sediment from runoff
 - obstructions to migration such as dams
 - fishing
8. Which of these hazards are natural and which are

a result of humans? Discuss the fact that even if humans were completely out of the picture, far more salmon are spawned than will ever survive to reproduce. Each species of animal or plant is capable of producing more offspring than are needed to just replace the individuals already alive. This allows species to survive predation and recover from natural changes or disasters. It also means that when natural controls, such as predators, are removed, populations may explode in size.

Extensions

1. What would happen if human-caused fish deaths were reduced? Have students choose one set of conditions to change. For example, fishing is no longer allowed. Replace these cards with blank cards and see what happens. Would they continue to increase forever? What are the possible consequences? Would the predator population increase? How would the competition for the food supply be affected?
2. Have students choose an aquatic or marine species that migrates and make their own

Activity adapted from *Living in Water Activity Guide*, written by Dr. Valerie Chase and published by the National Aquarium of Baltimore, Baltimore, Maryland 21202.



U.S. Fish and Wildlife Service, Paul Kerris

The Great Anadromous Fish Game

You have a run of salmon trying to reach the spawning grounds. There are 1,000 fish in this run. There are many dangers ahead. Each time you meet a hazard, deduct the number of fish that died. Use this chart to keep track of your fish population.

GOING TO THE SPAWNING GROUNDS: Number of fish to begin

OCEAN	ESTUARY	STREAMS

The number of adult fish that reached the spawning ground is_____.

Now how many alevin (sac fry) were produced ? Calculate as follows:

1. Roll the die. Your number was_____.
2. Multiply this times 10_____.
3. Multiply this number by the total number of adult fish to get the number of baby salmon that start down stream_____.

Now the fingerling/fry salmon head for the ocean. Keep track of the changes in the number of fish as they swim.

RETURNING TO THE OCEAN Number of fingerlings headed to the ocean

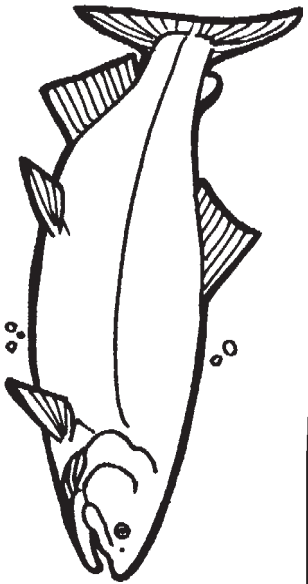
OCEAN	ESTUARY	STREAMS

The number of young salmon that reached the ocean is_____.

The average number of young salmon that reached the ocean for the group playing the game (Add all young together and divide by the number of players)_____.

Are the total number of salmon increasing each year or decreasing?

If you were a fisheries biologist, what actions would you take which could increase the number of salmon in future years?



CARD

CARD

CARD

ADULT
ESTUARY CARDS

ESTUARY
CARD

OCEAN
CARD

OCEAN
CARD

OCEAN
CARD

OCEAN
CARD

YOUNG SALMON
OCEAN CARDS

ADULT
OCEAN CARDS

OCEAN
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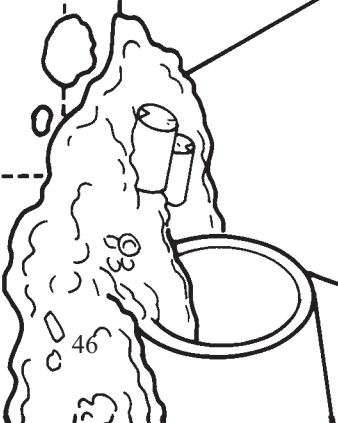
OCEAN
CARD

OCEAN
CARD

OCEAN
CARD

START
HERE

OCEAN



**SPAWNING
GROUNDS**

**STREAM
CARD**

**STREAM
CARD**

**YOUNG SALMON
STREAM CARDS**

**ADULT
STREAM CARDS**

**STREAM
CARD**

**STREAM
CARD**

**ESTUARY
CARD**

**ESTUARY
CARD**

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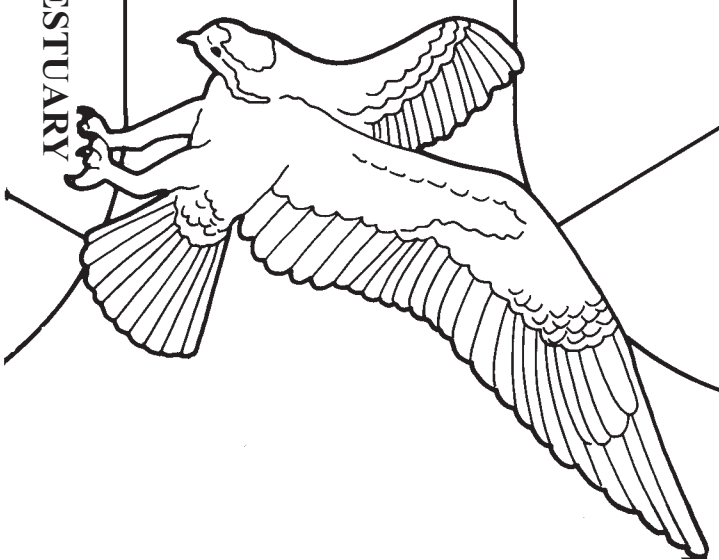
**ESTUARY
CARD**

**YOUNG SALMON
ESTUARY CARDS**

ESTUARY

ESTUARY

ESTUARY



Game Rules

Goal:

You are a salmon, and you are to produce as many offspring as possible by successfully swimming to the spawning grounds. After the spawning and hatching of young salmon, the fingerlings/fry swim back to the ocean. The player with the most fingerlings/fry making it to the ocean wins! But beware, there are many hazards lurking along the way.

ATTENTION: The game board may look strange because you begin at the bottom right. Remember adult salmon swim upstream to reach the spawning grounds.



How to play:

1. Shuffle the hazards card sets and place them in the marked locations.
2. Select your marker and place it in the Open Ocean. From the ocean you will swim into the estuary and then upstream to spawn. Young salmon then swim back to the ocean.
3. To start you have 1,000 salmon; record this number on the worksheet.
4. Roll the die. The highest number starts first. Play proceeds clockwise.
5. Roll the die to determine number of spaces to move. If you land on a space instructing you to draw a card, do so and read it aloud. Record the change in the number of fish on your worksheet.
6. While going to the spawning grounds, draw only ADULT cards.
7. Salmon may lay as many as 5,000 eggs, but not all of them hatch. Use the instructions on the worksheet to determine the number of alevin or sac-fry that will grow into fingerlings/fry and head back to the ocean.
8. When returning to the ocean, draw only YOUNG SALMON cards.
9. The player who gets the **most** fish back to the ocean wins, not